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(54) Abstract Title

Harvesting sea bed dwelling organisms.

(57) Apparatus for harvesting sea bed dwelling organisms, in particular razor shells, comprises a net or cage 4 and a blade 8 mounted on a frame 7 which is adapted to be towed along the sea bed. In addition, a feed pipe 9 discharges fluid under pressure adjacent to the blade to produce turbulence and a suction pipe 3 removes material collected in the net or cage. The blade is adapted to free the desired catch from the sea bottom and is preferably adjustable so that the angle and depth of penetration of the blade can be altered. The suction pipe preferably operates as an air lift pump (Fig. 4).

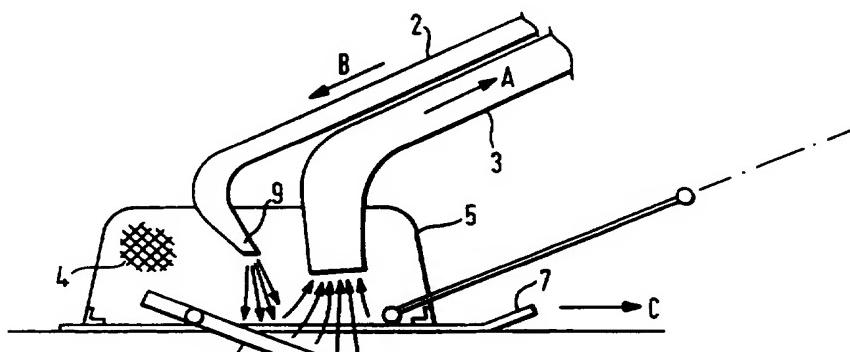


FIG. 2

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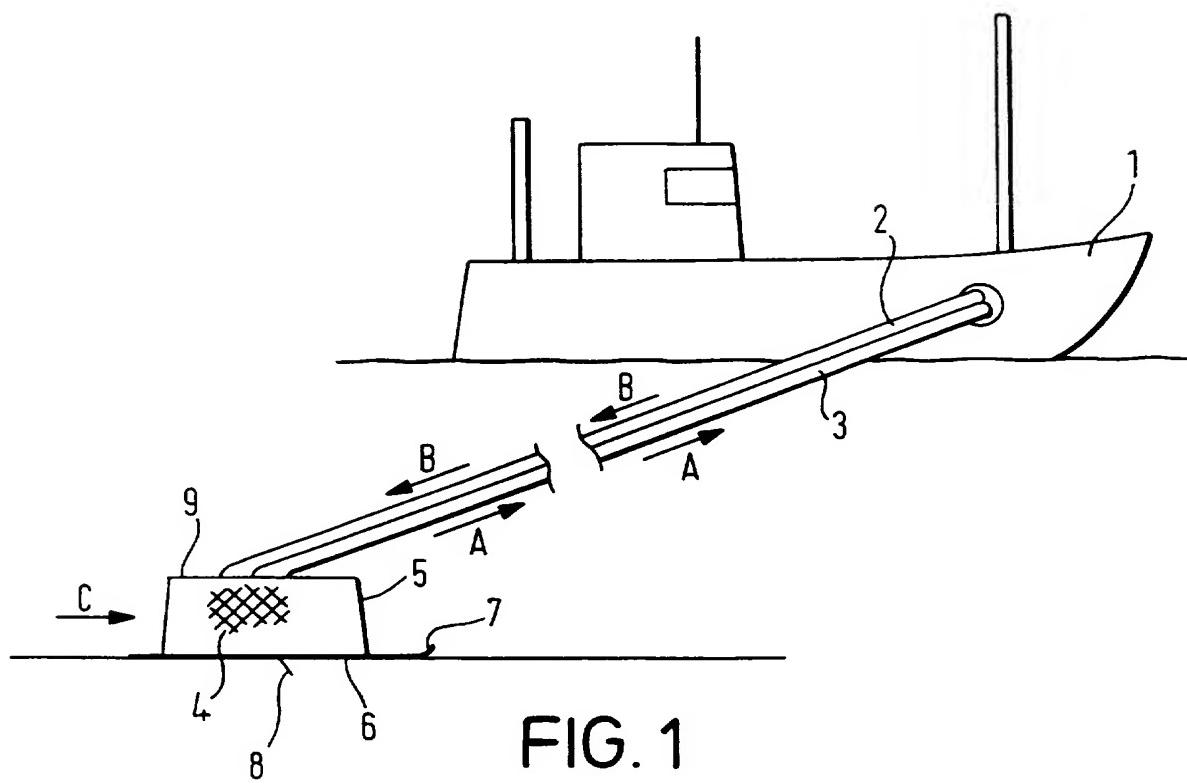
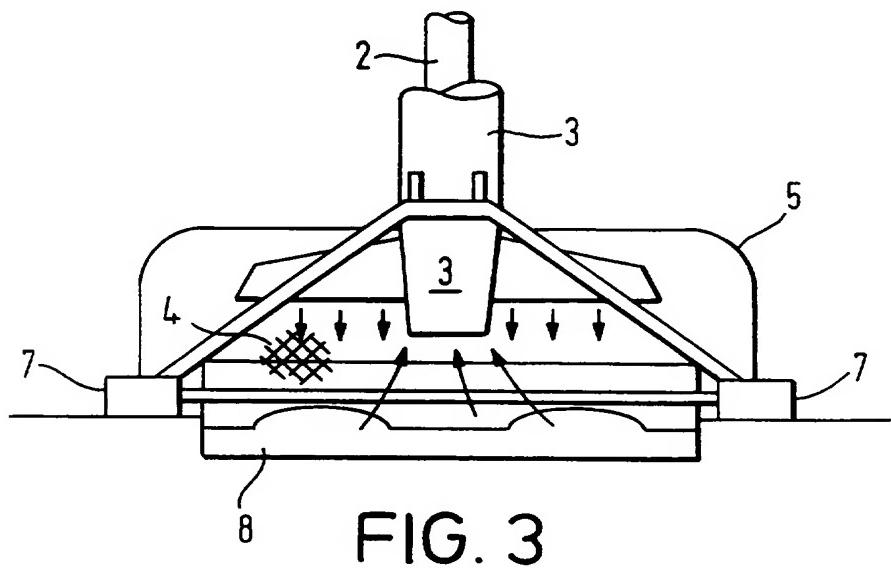
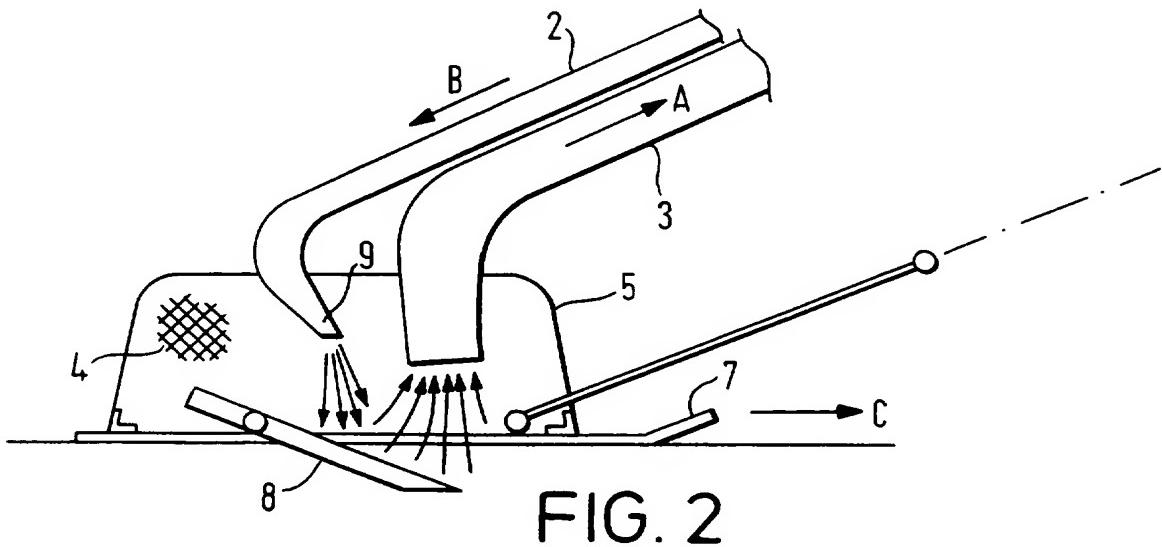


FIG. 1

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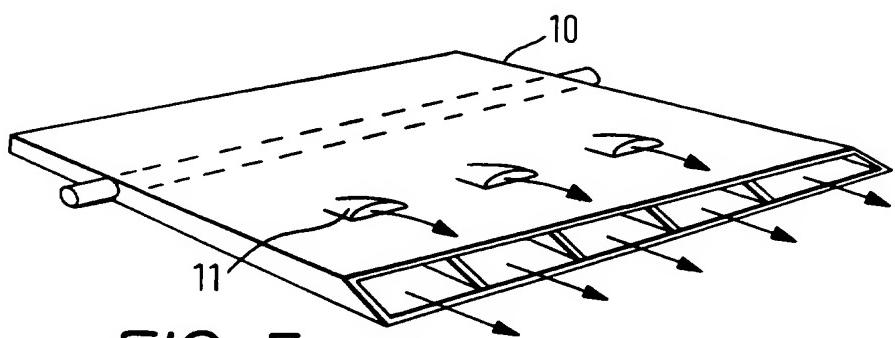
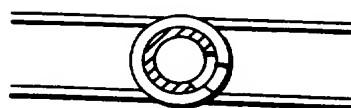
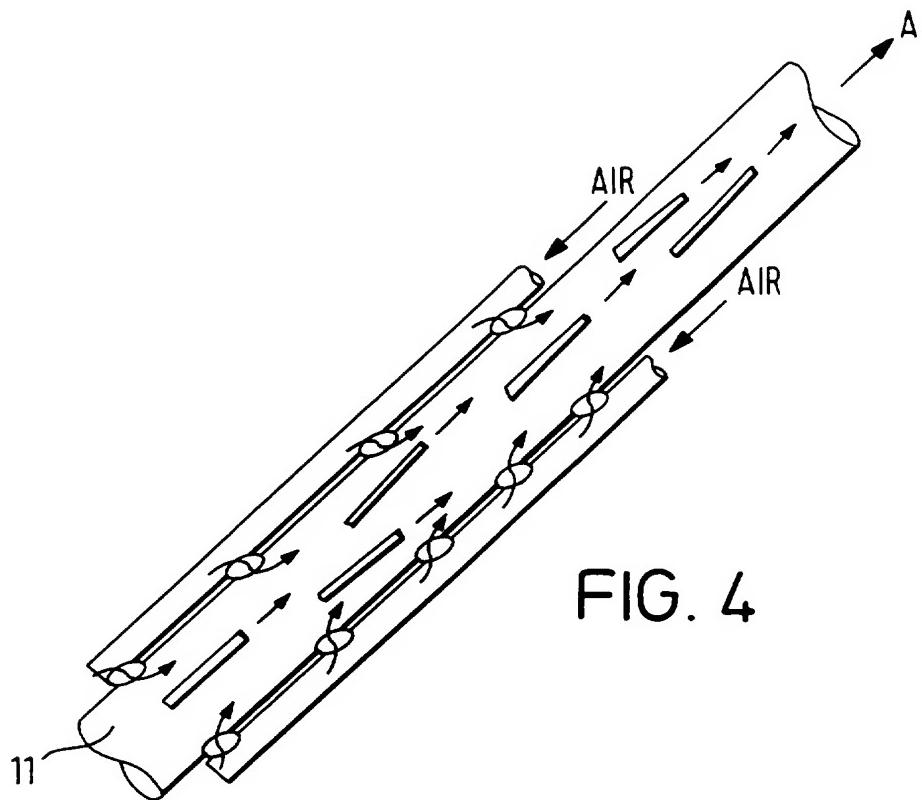


FIG. 5

TITLE**Method and Apparatus for Grubbing the Sea Bottom**

05 This invention relates to a method and apparatus for grubbing the sea bottom at shallow depth for the purpose of harvesting molluscs such as razor shells. Although primarily suitable for fishing coastal waters for razor shells or razor clams (*cultellus*) and cockles, the invention is also applicable to some varieties of fish which live in or near the bottom of
10 coastal waters.

 Harvesting razor shells demands a special knowledge. Razor shells stand normally upright in the sand on the sea bottom and as they have a total length of about 10 to 18 cm., do not stand out above the sandy bottom so that fishing on the bottom does not produce any result.
15 Only by grubbing the sea bottom over a depth which corresponds at least with the length of the razor shells, can they be removed from the sandy bottom and subsequently be transported to the deck, for example by means of a suction pipe which is connected to the top side of the trawl net or cage. For this purpose the suction pipe is connected to a centrifugal pump having a relatively large pump rotor and the razor shells or other marine products are thus transported through the pump rotor to a deck
20 mill where the razor shells are cleaned of sand and other useless material.

 Although this way of harvesting yields good results, more than
25 20% of the catch is inevitably damaged by the pump rotor in such a way

that they are no longer fit for consumption. Therefore it is important to reduce this high percentage to an acceptable percentage of 1 to 5% at the most. This applies on one hand to the catch and on the other hand to the environment of the sea bottom.

05 According to this invention there is provided a method for grubbing the sea bottom using a trawled net or cage or cage or the like for harvesting marine products, which is dragged across the sea bottom by a surface vessel, with a blade means adapted to dig into the sea bed by a preset cutting depth to disturb and free the desired catch from the sea
10 bottom within the confines of the net or cage, an air and/or water pressure jet being discharged adjacent the blade and suction being applied within the net or cage and through a conduit whereby any products thus disturbed are transported to a receiving container on the vessel.

15 The term "trawl net or cage" or "net" as used herein is intended to embrace not only a flexible net structure but also a rigid mesh or cage structure such as of metal, plastics or the like which is of a self supporting nature.

20 In this method of grubbing the sea bottom an accurately preset cutting depth is used and by means of a trawl net or cage device which is dragged over the sea bottom, the latter is locally grubbed at a shallow depth, the depth at least corresponding to the length of an average razor shell, over a width of e.g. 80 to 100 cm. with the application of compressed air and/or delivery water connections which are effective to harvest the razor shells without major damage.

25 This invention also provides apparatus for harvesting marine

products by grubbing the sea bottom, the apparatus comprising a net or cage forming an enclosure and mounted on a frame member which is adapted to be towed along the sea-bed, the frame member supporting a blade cutting device to dig into the sea bed to disturb same during towing,
05 a feed pipe conveying a pressure fluid into the net or cage for discharge adjacent the blade to produce turbulence, and a suction pipe for removing disturbed products from within the net or cage.

A water delivery outlet can be directed against the moving direction of the trawl net or cage and towards the top of the cutting device in order
10 to agitate the material disturbed, which is then extracted from the top side of the trawl net or cage through a water suction pipe to a receiving container on deck. The trawl net or cage is preferably equipped with a cutting device, which is mounted in an oblique angular position in the direction of movement of the trawl net or cage, the device extending over
15 the width of the trawl net or cage and having a length of about 100 cm. whereby the cutting depth of the cutting device is adjustable with respect to the bottom of a trawl net or cage .

By providing an adjustable cutting depth a considerable reduction in damage to the catch of razor shells is achieved during this first stage,
20 damage remaining well below the aforementioned 20%. In order to achieve a still greater reduction in the damage to the animal products it is important that dimensions of the ploughing area are such that outflowing water is directed straight at the cutting device. This enables on the one hand the trawl to be dragged using less power and on the other hand the catch is subject to less damage. In principle two possibilities are now
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feasible due to omission of the centrifugal pump. The first one has been described above, the second is that by means of compressed air the suction pipe for conveying the catch to deck is provided at least near the bottom with inlet openings for compressed air. These enable transport of animal products which are caught, such as razor shells, without mechanical damage caused by a pump rotor.

Furthermore the cutting device should extend over the full width of the trawl net or cage and it is possible for the cutting device to be subdivided into separate cutting elements which overlap across the width of the trawl net or cage. In this respect, the grubbing of the sea bottom can in some way be compared with a process of ploughing the sea bottom and the form given to normal ploughing devices can be applied.

To augment the action of the compressed air and/or water delivery jet on or near the top surface of the cutting device, the latter may have an undulating shape to assist the water jet in the transport of products to the suction pipe.

According to the invention the trawl net or cage is provided with mounting means for the cutting device or cutting devices and means are also provided for adjusting the cutting depth between, for example, 20 and 30 cm. Subject to the nature of the sea bottom it is also desirable that the angular position at which the cutting device grubs the sea bottom is adjusted by tilting means.

In order to effect grubbing in the most efficient way and to minimise the temporary disruption to the sea bottom it is proposed to make the cutting device hollow and have this hollow cutting device also operate as

delivery for compressed water.

The object of the invention is to bring as much as possible undamaged shellfish product, such as razor shells, to the surface, using a water and/or air jet or by means of both systems.

05 If compressed air is used for upwardly transporting the razor shells, a so-called Rootsblower, a positive displacement pump or compressor of a known type installed on deck will suffice for this purpose. The maximum catch depth is 12 to 16 m approximately and by injecting air into a booster duct the operation is that of a so-called air lift pump. In a centrifugal
10 pump hitherto used a flow rate of approximately 400 m³ was accepted, a higher flow rate appearing to lead to more sand recovery which increases the wear of the pump housing and pump rotor and furthermore the discharge of sand from the deck caused problems. On the contrary with a positive displacement pump no problem arises as no wear occurs using
15 compressing air and the pressure height can be easily overcome within a wide range of the sea bottom.

This invention will be further described and explained in more detail with reference to the following description taken in conjunction with the drawings showing preferred embodiments of apparatus and illustrating
20 the method of this invention. In the drawings:

- Figure 1 is a schematic side view of a fishing vessel which is provided with means to carry out the method of this invention,
- Figure 2 is a schematic side view of a trawl net or cage which is equipped with a cutting device and in accordance
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- with this invention,
- Figure 3 is a front view of the trawl net or cage in Figure 2,
Figure 4 is a schematic side view of an airlift pump device for
use in the method according to this invention, and
05 Figure 5 shows a hollow cutting or ploughing device according
to this invention.

Referring to the drawings and particularly to Figure 1, two pipes are attached to the forward side of the fishing vessel 1 by means of a 10 rotatable pipe coupling. The pipe coupling makes it possible to maintain the freedom of movement of the vessel during swell and sea wave motion. Compressed air is supplied through the upper compressed air pipe 2 and through the second conveying pipe or suction pipe 3, water including the catch is raised to the deck of the vessel by means of a 15 pump. The arrow directions A and B represent the direction of flow within the pipes 2 and 3. Both pipes are connected at the sea bottom to a trawl net or cage device formed by an elongated cage 5, having an open lattice structure 4, which is mounted on a sledge frame 6 capable of sliding over the sea bottom. The frame 6 comprises two parallel supports 20 7 which at their front side are somewhat bowed upwards like the tip of a ski. Thus the trawl net or cage 5 does not dig into the sea bottom when dragged by the vessel 1 in the direction of arrow C.

Across the width of the trawl net or cage 5 and crosswise to the moving direction according to arrow C, a blade-like cutting device 8 is 25 mounted on the frame 9 of trawl net or cage 5. During the operation for

harvesting razor shells the cutting device is adjusted at such depth that
only slight local grubbing of the sea bottom takes place by which the
vertically located razor shells are undercut. This undercutting is
accompanied by directing an air and/or water jet stream onto the front
05 side of the cutting device 8 to effect localised grubbing of the sea bottom.
If there are razor shells, they are lifted from the sand on the sea bottom in
which they are located and raised to deck by means of the suction
operation in conveying pipe 3. With an air lift pump used for conveying
pipe 3, a compressed air connection is mounted at one or more locations
10 within conveying pipe 3. This injection of compressed air causes an
upward jet stream effect by which the catch is lifted to the surface. By
eliminating transport of the razor shells through a pump rotor of a
centrifugal pump, considerably less damage occurs through breakage of
the shells. In figure 2 the trawl net or cage 5 of Figure 1 is shown in a
15 more detailed way. The direction of the flow of grubbing compressed air
and/or delivery water is schematically shown and issues from the spray
pressure nozzle 9 in the direction of the cutting device 8. The cutting
device 8 which is adjusted at the desired cutting depth causes the release
of the razor shells whereafter the razor shells are brought to deck through
20 the operation of suction or compression. The direction of pressure flow
at the outlet on the front and top side of the cutting device 8 and the rate
of velocity of the pressure and/or suction operation are adjusted from the
deck, preferably in such a way that the amount of sand which is
transported upwards remains as small as possible. In view of the fact
25 that the water immediately surrounding the dragged trawl net or cage 5 is

almost opaque caused by the cutting device 8 and the turbulence, attention must be paid to the composition of the water brought to the deck together with the catch, which flows immediately back into the sea, by means of which the pressure and the flow velocity must be adjusted.

05 There are in fact two possibilities with respect to the use of turbulence which grubs the sea bottom. The inlet for the compressed air or water jet stream can be mounted in reverse to the direction of movement of the trawl net or cage 5, and also a strong current can be generated which also follows the direction of movement of trawl net or
10 cage 5. The choice for one or the other depends also on the direction of motion and the direction of the current over the sea bottom. Where a hollow cutting device 10 is used, as shown in Figure 5, the outflow openings 11 can be provided which discharge on the top of the surface of the cutting device and which are directed in such a way that the effect
15 thereof occurs at the lower front side of cutting device 10. If cutting device 10 is provided over its full width with a hollow outlet, reinforced by cross bracing, the cutting device 10 can have a double function. On the one hand it operates as a cutting device for grubbing the sea bottom, and on the other hand it forms an outlet through which the turbulent water
20 flows to the outside.

In the embodiment in Figure 4 the operation of the air lift pump is shown for bringing up the razor shells and conveying them to the deck. By the injected air enclosed in the catch pipe 11 the water, including the catch, is raised to the deck by the buoyant air. In the method grubbed sand is left as much as possible near to the sea bottom and this can be
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achieved by a correct choice of cutting depth (e.g. 25 cm) and trawl speed (e.g. 250 m/hour) as well as by the nature and shape of the cutting device and empirical determination of the applied pressures.

In order to achieve an optimal catch by means of the method of
05 this invention whereby the sea bottom is only grubbed in a slight way, another embodiment is provided wherein the trawl net or cage 5 is provided on the front side near the cutting device 8 with a number of electrodes shaped as pins or plates between which a slight voltage tension is maintained. The salt sea water is a good conductor of
10 electrical current and by maintaining a certain electric voltage marine life can be attracted or slightly paralysed before being pumped up to deck through the riser duct A.

The cutting device 8 which is exposed to a great degree of wear will be constructed, at least with respect to the parts which are affected
15 most, of a material such as manganese steel of high durability and corrosion resistance.

It is also useful to let the rear of the cutting device rotate around a hinge pin which is mounted on the frame of the trawl net or cage. The angular position of the cutting device with respect to the axis of rotation
20 and thus with respect to the bottom of the trawl net or cage can thus be changed. It is therefore possible to adjust the cutting depth by rotating the cutting device and subsequently fixing the position.

If an estimate based on an actual catch is made for razor shells, a catch of 10 tons of unbroken razor shells can be obtained in, for example,
25 one week. In the usual catch method 2 tons of broken razor shells,

unsuitable for consumption have to be discarded. The fishing method of this invention can be less intensive because for this catch the sea bottom surface to be grubbed is smaller due to the increase of the useful catch of razor shells. If the number of fishing days is fixed at, say, 150 days per year, a significant saving is achieved by the application of the method, both with respect to the sea bottom environment as to the limits which are possibly required with respect to the aspect of overfishing razor shells. By means of this invention it becomes very easy to determine whether or not razor shells are present in any useful quantity in front of the trawl net or cage, without heavily grubbing the sea bottom. These razor shells are easy to locate and visible when they are unbroken and raised to the deck so that the quantity thereof can be determined at the fishing site and a decision made as to whether to continue or stop the catch.

CLAIMS

1. Method for grubbing the sea bottom using a trawled net or cage for harvesting marine products, which is dragged across the sea bottom by a surface vessel, with a blade means adapted to dig into the sea bed by a preset cutting depth to disturb and free the desired catch from the sea bottom within the confines of the net or cage, an air and/or water pressure jet being discharged adjacent the blade and suction being applied within the net or cage and through a conduit whereby any products thus disturbed are transported to a receiving container on the vessel.
2. Method in accordance with Claim 1, wherein the trawl net or cage includes the blade means forming a cutting device mounted on a base set at an oblique angular position, the cutting device extending across the width of the trawl net or cage, means being provided to adjust or preset the required cutting depth of the cutting device and/or the angular position of the blade with respect to the base of the trawl net or cage.
3. Method in accordance with Claim 1 or 2, wherein the blade means is secured to the trawl net or cage and extends over the width thereof and is positioned centrally along the length of the trawl net or cage with the blade positioned forwardly towards an open front of the trawl net or cage, the suction preferably being applied forwardly of the pressure jet discharge.

4. Method according to Claims 1, 2 or 3, wherein the position of the cutting device provides a cutting depth of 10 to 30 cm and that the direction of the outlet of the pressure jet is directed in such a way, preferably against the direction of movement, that disturbed sediment on
05 or near the blade surface is impinged on by the discharging jet.

5. Apparatus for harvesting marine products by grubbing the sea bottom, the apparatus comprising a net or cage forming an enclosure and mounted on a frame member which is adapted to be towed along the sea-
10 bed, the frame member supporting a blade cutting device to dig into the sea bed to disturb same during towing, a feed pipe conveying a pressure fluid into the net or cage for discharge adjacent the blade to produce turbulence, and a suction pipe for removing disturbed products from within the net or cage.

15 6. Apparatus in accordance with Claim 5, wherein a front side of the net or cage is open, relative to the towed direction the apparatus being adapted for towing by a surface vessel with the feed pipe and suction pipe extending to a coupling on said vessel.

20 7. Apparatus in accordance with Claim 5 or 6, wherein the frame member comprises a skid structure with spaced side rails supporting the net or cage, the blade being located between and extending the width of the rails.

8. Apparatus in accordance with any one of Claims 5 to 7, wherein the frame is of metal and is provided with an adjustable fixing means on which the cutting device can be mounted.
9. Apparatus according to Claim 8 wherein the fixing means has adjusting means in order to adjust the penet or cageration depth of the blade cutting device into the sea bed.
10. Apparatus according to Claim 9, wherein the fixing means are provided with angular tilting means in order to adjust the angle of the cutting device with respect to the sea bed.
11. Apparatus according to any one of the preceding Claims 5 to 10, wherein the cutting device is positioned on the front end of a flat element which serves as a support for the cutting device.
- 15 12. Apparatus according to Claim 11, wherein the end of the cutter support opposite the cutting blade is provided with means to preset the required angular cutting position and/or depth of the cutting device.
- 20 13. Apparatus according to Claim 11 or 12, wherein the flat element is provided with a number of discharge openings on an upper surface for delivery of pressure fluid which is fed through a hollow part of said element, the pressure fluid preferably comprising water with injection of compressed air.

14. Apparatus according to Claim 13, wherein the cutting device support includes a hinge to adjust the blades, preferably a hollow hinge and through which pressure fluid is fed.

05 15. Apparatus according to any preceding Claim 12 to 15, wherein the cutter support and the cutting device are hollow over substantially the complete width and include internal reinforcing webs, pressure fluid being fed into the support.

10 16. Apparatus according to any preceding Claim 5 to 15, wherein the cutting device has a flat front face and has an undulating or toothed profile to reduce drag.

15 17. Apparatus according to any preceding Claim 5 to 16, wherein the net or cage at a front side adjacent the cutting device is provided with a number of electrodes for application of an electrical voltage.

20 18. Method or apparatus according to any one of the preceding claims, wherein suction is applied through a suction pipe coupled with a compressor for producing lift in the suction pipe.

19. Method or apparatus according to Claim 14, wherein the compressor injects a volume of air into the lower part of a riser duct forming part of the suction pipe and operating as an air lift pump.

25 20. A vessel incorporating apparatus or using a method according to

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any one of the preceding claims.

21. Apparatus or a method for harvesting animal products from the sea
bed constructed or arranged to function as described herein and
05 exemplified with reference to the drawings.

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Claims searched: 1 to 21

Examiner: Matt Jefferson
Date of search: 8 January 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Int Cl (Ed.6): A01K 74/00, 79/00, 80/00; EO2F 3/88, 5/00.

Other: Online: EPODOC, PAJ, WPI.

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 1156547 (WHITE FISH AUTHORITY) See page 2, line 34 to page 3, line 65 and figures.	X: 1, 5 to 7, 11 & 18. Y: 19 & 20.
Y		
X	US 5027533 (HOLT ET AL.) See whole document.	X: 1, 4 to 7 & 18 Y: 19 & 20.
Y		
Y	US 4551042 (HAGEDORN ET AL.) See figures.	18 to 20.
Y	US 4434572 (SHELDON ET AL.) See figures.	18 to 20.
X	US 3783535 (HANKS) See whole document.	X: 1, 2, 5, 6 & 8 to 11. Y: 18 to 20.
Y		

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

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